

O. Penezina, et al.
U.S.S.N.: 10/646,292
Page 8 of 20

RECEIVED
COMM-FAX UNIT
SEP 27 2006

REMARKS

Claims 1-22, 48, and 49 are pending. Claims 50-58 are added. No new matter has been added by virtue of the amendments, support for the amendments being found in the original claims and throughout the originally filed specification, claims, and figures (e.g. see page 12, lines 21-25; page 10, lines 15-16; and Examples 1-7)

1. 35 U.S.C. 102/103 Rejections

Steuck et al.

Claim 1

Claims 1-6, 9-14, 19-22, 48, and 49 are rejected under 35 U.S.C. 102(a) or, alternatively, under 35 U.S.C. 103(a) over *Steuck et al* (US 4,618,533).

Applicants respectfully traverse.

Applicants claim, in independent claim 1, a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules. Each difunctional surface-modifying molecule comprises a hydrophobic portion preferentially associated with the substrate and a hydrophilic portion. The surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane.

The Office reasserts its previous statements that *Steuck* teaches a hydrophobic substrate coated with difunctional surface-modifying molecules. In particular, the Office asserts that *Steuck*'s hydrophobic portion includes tetraethylene glycol diacrylate (col. 4, lines 1-5) and that the hydrophilic portion includes hydroxyalkyl methacrylate (col. 3, lines 50-60). The Office acknowledges that "*Steuck* does not specifically disclose the surface modifying molecules to form a crosslinked hydrophilic polymeric network at the surface of the membrane as well as the hydrophobic portion associated with the substrate. However, it appears that *Steuck* uses the same materials and technique to modify the surface of the porous membrane." (3/29/05 Office action, page 5).

O. Penczina, et al.
U.S.S.N.: 10/646,292
Page 9 of 20

Applicants respectfully disagree.

According to Steuck, the membrane is contacted with a reagent bath containing (1) a free radical polymerizable monomer, (2) a polymerization initiator, and (3) a cross-linking agent, in solvent which results in free radical polymerization of the monomer and coating of the porous membrane with the cross-linked polymer (col. 3, lines 36-42). As the free radical polymerizable monomer, hydroxyalkyl methacrylate is listed as an example (see col. 3, lines 49-50). As the cross-linking agent, tetraethylene glycol diacrylate is listed as an example (see col. 4, lines 1-5).

Thus, the Office is asserting that Steuck's (3) cross-linking agent and (1) polymerizable monomer form a difunctional surface-modifying molecule, with the cross-linking agent being a "hydrophobic portion" and the polymerizable monomer being a "hydrophilic portion."

According to Steuck, the polymerizable monomer ("hydrophilic portion") is polymerized by free radical polymerization and is cross-linked with cross-linking agent ("hydrophobic portion") to form a coating on the membrane. Applicants respectfully submit that making hydrophobic porous membrane surfaces hydrophilic via coating and polymerization of hydrophilic monomers technique is in accordance with known techniques that are different than the technique taught by Applicants.

Applicants respectfully submit that these known techniques require a sufficient amount of monomer in order to deposit a hydrophilic coating throughout the membrane void structure after polymerization. Small amounts of di-functional monomer are used for cross-linking to provide a branched three dimensional structure of the hydrophilic coating interpenetrating the membrane porous structure. However, this conventional hydrophilization process causes pore blockage as the cross-linked coating reduces the available void space for liquid passage (as shown in Figure 1A of the present application). The polymerizable monomer, which is mono-functional, can only produce a linear chain after polymerization.

O. Penevina, et al,
U.S.S.N.: 10/646,292
Page 10 of 20

Applicants further submit that, according to Steuck, a crosslinked hydrophilic monomer, which cannot interact with the hydrophobic substrate, is grafted onto another monomer containing a hydrophobic portion. It is this hydrophobic portion that, then, interacts with the substrate. While achieving the objective of hydrophilization, the grafting technique employed by Steuck substantially adds on to the thickness of the substrate, decreasing the pore sizes and contributing to reduced flow rates through the coated membranes.

Thus, contrary to the Examiner's assertion, Steuck does not use the same materials and technique to modify the surface of the porous membrane. Applicants respectfully submit that, as a result, Steuck's technique and materials will not provide coated membranes in accordance with Applicants' claims.

Applicants further submit that Steuck's coated membranes would not be in accordance with Applicants claims as further demonstrated by the SEM photos submitted herewith (and previously submitted to the Office).

Applicants note that the Office asserts, in the June 27, 2006 Office action, that the SEM photos are not sufficient to overcome the art rejections since they are not related to the Steuck membrane (see page 5). Applicants respectfully disagree and apologize for any confusion that may have resulted in the prior submission of the SEM photos. In particular, Applicants referred to the SEM photos as relating to "Millipore" membranes. However, Applicants note that these membranes were membranes made in accordance with Steuck (US 4,618,533), which is assigned to Millipore and, thus, were referred to as "Millipore" membranes.

When comparing the SEM of Example 1, which shows side 1 of a hydrophobic membrane, to the SEM of Example 2, which shows side 2 of the coated hydrophilic membrane in accordance with Steuck, it is clearly demonstrated that membranes coated in accordance with Steuck result in greater coating deposits, weight gain, and greater flow reduction (as shown by the darker and bigger spots). This is also demonstrated when comparing the SEM of Example 3,

O. Penczina, et al.
U.S.S.N.: 10/646,292
Page 11 of 20

which shows side 2 of a hydrophobic membrane, to Example 4, which shows side 2 of the coated hydrophilic membrane in accordance with Steuck.

On the other hand, as demonstrated by the SEM photos of Examples 5-8, which show hydrophobic and coated hydrophilic membranes in accordance with Applicants' invention, the coatings are not visible, do not add measurable weight or thickness to the original (uncoated) membranes, and do not cause pore blockage or membrane flow rate reduction.

Claim 50

Applicants further claim, in new claim 50, a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, each difunctional surface-modifying molecule comprising a hydrophobic portion preferentially associated with the substrate and a hydrophilic portion, wherein the surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane, and wherein the pore sizes of the coated composite porous membrane is substantially the same as the pore size of the composite porous membrane before coating.

Applicants provide a hydrophobic substrate coated with difunctional surface-modifying molecules wherein the desirable bulk properties of the underlying substrate (e.g. pore size) are maintained. According to Applicant, only di-functional monomer is used. This allows for a tight three dimensional structure of the finished hydrophilic coating. The di-functional monomer molecule must have a hydrophobic section. This hydrophobic section of the molecule affords longer interactions and interacts favorably with the hydrophobic substrate surfaces. This hydrophobic interaction promotes adsorption of Applicants' monomer onto the membrane surfaces before polymerization takes place (before UV treatment). This extended interaction of hydrophobic-hydrophobic surfaces before UV treatment not only promotes adsorption of the monomer but also affords the ability to directly react the applied chemistry to the membrane surface without dependence of chemistry to chemistry reactions. When the monomer solution is introduced into the pores of the substrate, the random distribution of monomer in solution is

O. Penczina, et al.
U.S.S.N.: 10/646,292
Page 12 of 20

affected by the preferential adsorption, and the monomers will congregate along the external & internal surfaces of the hydrophobic substrate. (see Figures 1A and 1B of the present application)

This is in contrast with prior coated substrates, such as Steuck, which exhibit reduced pore size due to polymerization across pores. Using Steuck's materials and techniques, a large amount of monomers is required in order to deposit a hydrophilic coating throughout the membrane void structure after polymerization. Steuck's monomer is capable of producing only linear chains after polymerization and do not produce three dimensional structures. Small amounts cross-linkers are used to provide a branched three dimensional structure of the hydrophilic coating interpenetrating the membrane porous structure. However, this hydrophilization process causes pore blockage as the cross-linked coating reduces the available void space for liquid passage (this is shown in Figure 1A of the present application).

Steuck's materials and techniques demonstrated significant weight gain (see Tables 2 and 6) accompanied with water permeability reduction after coating (pore blockage/reduced pore size)(see Tables 2 and 6; attached Examples 1-4 SEM photos).

Thus, claim 50 is patentable over Steuck.

Claims 51-52

Applicants further claim, in claim 51, a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, each difunctional surface-modifying molecule comprising a hydrophobic portion preferentially associated with the substrate and a hydrophilic portion, wherein the surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane, wherein the coating is provided on the hydrophobic substrate by exposure to a reagent solution comprising less than 1% difunctional surface-modifying molecule.

Similarly, in claim 52, Applicants claim a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, the coating providing a wettable membrane, each difunctional surface-modifying molecule comprising a

O. Penczina, et al.
U.S.S.N.: 10/616,292
Page 13 of 20

hydrophobic portion preferentially associated with the substrate and a hydrophilic portion, wherein the surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane, wherein the coating is provided on the hydrophobic substrate by exposure to a reagent solution comprising difunctional surface-modifying molecule, and wherein the reagent solution requires less than 1% difunctional surface-modifying molecule to provide the wettable membrane.

Applicants teach a wettable membrane (which is defined at page 10, lines 15-16 of the present application as a membrane which is wetted across its entire surface without phobic patches) that is provided with a reduced concentration of surface-modifying molecules. Applicants are able to achieve wettability because of the preferential absorption of the difunctional hydrophilic monomer (both external & internal). The chemistry of Applicants difunctional hydrophilic monomer allows a more uniform coating (Example 1 of our application).

Steuck requires at least 1-20% polymerizable monomer ("hydrophilic portion") based on weight of reactant solution, and 0.4-100% cross-linking agent ("hydrophilic portion") based on the weight of polymerizable monomer (see col. 4, lines 33-41). There is no teaching or suggestion that these amounts should or could be reduced to provide a coated membrane as claimed.

Thus, claims 51 and 52 are patentable over Steuck. Claims 53-54 depend from claims 51 and 52 and, likewise, are patentable over Steuck.

Claim 55

Applicants claim, in claim 55, a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, each difunctional surface-modifying molecule comprising a hydrophobic portion preferentially associated with the substrate and a hydrophilic portion, wherein the surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane, wherein the flow rate through the pores of the coated membrane is substantially the same as the flow rate through the pores of the non-coated membrane.

O. Penezina, et al.
U.S.S.N.: 10/646,292
Page 14 of 20

As set forth above with respect to claim 50, Steuck's materials and techniques demonstrated significant weight gain (see Tables 2 and 6; attached Examples 1-4 SEM photos) accompanied with water permeability reduction (see Tables 2 and 6) after coating.

Thus, claim 55 is are patentable over Steuck. Claims 56-57 depend from claim 55 and, likewise, are patentable over Steuck.

Claim 58

Applicants claim, in claim 58, a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, the difunctional surface-modifying molecules comprising ethoxylated (30) bisphenol A diacrylates, each difunctional surface-modifying molecule comprising a hydrophobic portion preferentially associated with the substrate and a hydrophilic portion, wherein the surface-modifying molecules are crosslinked to form a crosslinked hydrophilic polymeric network at the surface of the membrane.

Applicants respectfully submit that nowhere in Steuck is a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules comprising ethoxylated (30) bisphenol A diacrylates taught or suggested.

Accordingly, claim 58 is patentable over Steuck.

Wang et al.

Claim 1

Wang describes an extension of the conventional hydrophilization method as described by Steuck (US 4,618,533) so as to include charged groups of the coated membrane. According to Wang, a cationic polyamine epichlorohydrin resin is included in the treatment solution and, after radical initiated polymerization, the modified membrane contains a positive charged group on its surface.

O. Penezina, et al.
U.S.S.N.: 10/646,292
Page 15 of 20

The Office reasserts its previous statements that Wang teaches a hydrophobic substrate coated with difunctional surface-modifying molecules. In particular, the Office asserts that Wang's hydrophobic portion includes tetraethylene glycol diacrylate (col. 4, lines 64-65) and that the hydrophilic portion includes hydroxyalkyl methacrylate (col. 4, lines 42-43).

According to Wang, a hydrophobic substrate is modified by passing it through a solution comprising (a) a hydrophilizing component of a monomer capable of being polymerized by free radical polymerization ("polymerizable monomer") and which is cross-linked with a cross-linking agent and a nonionic and cationic polymerization initiator and (b) a charge modifying agent (see col. 3, lines 42-50). As the polymerizable monomer, hydroxyalkyl methacrylates is one example (col. 4, lines 41-43), and as the cross-linking agent, tetraethylene glycol diacrylate is one example (col. 4, lines 63-64).

Thus, as with Steuck, the Office is asserting that Wang's cross-linking agent and polymerizable monomer form a difunctional surface-modifying molecule, with the cross-linking agent being a "hydrophobic portion" and the polymerizable monomer being a "hydrophilic portion."

Applicants respectfully submit that making hydrophobic porous membrane surfaces hydrophilic via coating and polymerization of hydrophilic monomers technique is in accordance with known techniques that are different than the technique taught by Applicants. Thus, as with Steuck, contrary to the Examiner's assertion, Wang does not use the same materials and technique to modify the surface of the porous membrane. Applicants respectfully submit that, as a result, Wang's technique and materials will not provide coated membranes in accordance with Applicants' claims. Rather, coated membranes in accordance with Wang's technique and materials will result in greater coating deposits, weight gain, and greater flow reduction

O. Penezina, et al.
U.S.S.N.: 10/646,292
Page 16 of 20

Accordingly, claim 1 is patentable over Wang. Claims 2-6, 9-14, 20, and 48-49 depend from claim 1 and, likewise, are patentable over Wang. Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 50

Wang at least fails to teach or suggest a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, wherein the pore sizes of the coated composite porous membrane is substantially the same as the pore size of the composite porous membrane before coating.

As set forth above with respect to claim 1, coated membranes in accordance with Wang's technique and materials will result in greater coating deposits, weight gain, and greater flow reduction.

Accordingly, claim 50 is patentable over Wang.

Claims 51-52

Wang at least fails to teach or suggest a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, wherein the coating is provided on the hydrophobic substrate by exposure to a reagent solution comprising less than 1% difunctional surface-modifying molecule (claim 51) or wherein the reagent solution requires less than 1% difunctional surface-modifying molecule to provide the wettable membrane (claim 52).

As set forth by Wang, the polymerizable monomer is present in the reactant solution at a concentration between about 1% and about 20%, and the cross-linking agent is present in an amount between about 0.01 and 90% by weight based on the weight of the polymerizable monomer (see col. 5, lines 23-31). There is no teaching or suggestion that these amounts should or could be reduced to provide a coated membrane as claimed.

O. Penczina, et al.
U.S.S.N.: 10/646,292
Page 17 of 20

Accordingly, claims 51 and 52 are patentable over Wang.

Claim 55

Wang at least fails to teach or suggest a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, wherein the flow rate through the pores of the coated membrane is substantially the same as the flow rate through the pores of the non-coated membrane.

As set forth above with respect to claim 1, coated membranes in accordance with Wang's technique and materials will result in greater coating deposits, weight gain, and greater flow reduction.

Accordingly, claim 55 is patentable over Wang.

Claim 58

Applicants respectfully submit that nowhere in Wang is a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules comprising ethoxylated (30) bisphenol A diacrylates taught or suggested.

Accordingly, claim 58 is patentable over Wang.

Callahan et al.

Claim 1

Callahan describes a composite membrane that is coated with a UV curable polymer having a high viscosity that provides substantially reduced pore filling compared with prior art coated membranes (col. 2, lines 58-63). As set out, with conventional materials and methods, UV reactive mixtures, after coating, tend to wick up and fill pores (col. 2, lines 13-15). Callahan's methods and materials avoid "significant pore filling" (col. 3, lines 1-4). Callahan accomplishes this by using a UV curable resin having a viscosity of at least 35,000 cp.

O. Penczina, et al.
U.S.S.N.: 10/646,292
Page 18 of 20

Applicants note that these viscosities required by Callahan are significantly larger than those used Applicants (150 – 200 cp).

Thus, Callahan utilizes significantly different materials than those used by Applicants. Applicants respectfully submit that, as a result, Callahan will not provide coated membranes in accordance with Applicants' claims. Applicant respectfully submits that Callahan's materials and techniques yield a coated material having pore sizes that are magnitudes smaller than the pore size of the uncoated substrate. Applicant, on the other hand, teaches coated membranes, wherein the coatings are not visible, do not add measurable weight or thickness to the original (uncoated) membranes, and do not cause pore blockage or membrane flow rate reduction.

Accordingly, claim 1 is patentable over Callahan. Claims 2-6, 9-14, 20, and 48-49 depend from claim 1 and, likewise, are patentable over Callahan. Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 50

Callahan at least fails to teach or suggest a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, wherein the pore sizes of the coated composite porous membrane is substantially the same as the pore size of the composite porous membrane before coating.

As set forth above, Callahan's materials and techniques yield a coated material having pore sizes that are magnitudes smaller than the pore size of the uncoated substrate.

Accordingly, claim 50 is patentable over Callahan. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 51-52

Callahan at least fails to teach or suggest a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, wherein the

O. Penezina, et al.
U.S.S.N.: 10/646,292
Page 19 of 20

coating is provided on the hydrophobic substrate by exposure to a reagent solution comprising less than 1% difunctional surface-modifying molecule (claim 51) or wherein the reagent solution requires less than 1% difunctional surface-modifying molecule to provide the wettable membrane (claim 52).

As set out by Callahan, the UV reactive polymeric material is present in the mixture in an amount of about 1-99% based on weight. There is no teaching or suggestion that these amounts should or could be reduced to provide a coated membrane as claimed.

Accordingly, claims 51 and 52 are patentable over Callahan.

Claim 55

Callahan at least fails to teach or suggest a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules, wherein the flow rate through the pores of the coated membrane is substantially the same as the flow rate through the pores of the non-coated membrane.

As set forth above, Callahan's materials and techniques yield a coated material having pore sizes that are magnitudes smaller than the pore size of the uncoated substrate. As a result, flow through the pores would be significantly reduced.

Accordingly, claim 55 is patentable over Callahan. Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 58

Applicants respectfully submit that nowhere in Callahan is a composite porous membrane comprising a hydrophobic substrate coated with difunctional surface-modifying molecules comprising ethoxylated (30) bisphenol A diacrylates taught or suggested.

Accordingly, claim 58 is patentable over Callahan.

O. Penczina, et al.
U.S.S.N.: 10/646,292
Page 20 of 20

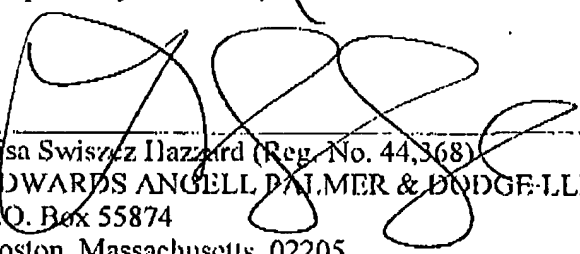
CONCLUSION

In view of the foregoing, Applicants request reconsideration and allowance of claims 1-22 and 48-58.

It is believed that no fees are required for consideration of this response. However, if for any reason the fee paid is inadequate or credit is owed for any excess fee paid, the Office is hereby authorized and requested to charge Deposit Account No. 04-1105.

Respectfully submitted,

Date: September 27, 2006



Lisa Swiszez Hazzard (Reg. No. 44,368)
EDWARDS ANGELL PALMER & DODGE LLP
P.O. Box 55874
Boston, Massachusetts 02205
Tel. No. (617) 517-5512

Customer No. 21,874